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Full Length Article

Assessing motor proficiency in young adults: The Bruininks Oseretsky Test-2 Short Form and the McCarron Assessment of Neuromuscular Development

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ABSTRACT

Currently, only two motor tests have norms extending into young adulthood – the McCarron Assessment of Neuromuscular Development (MAND, McCarron 1997) and the Bruininks Oseretsky Test of Motor Proficiency-2 (BOT-2, Bruininks & Bruininks, 2005). Research into the motor difficulties in early adulthood and health outcomes has been impeded because there is no agreed gold standard motor test for this group. The purposes of this study were to compare the discrimination accuracy, classification agreement, and predictive values, and gender distribution and prevalence of each test in identifying motor impairment (MI) in relation to DSM-V diagnostic criteria for DCD. Ninety-one young, healthy adults (M = 21.4 years, SD = 3.3) were recruited. Those classified as MI by each test scored at one standard deviation or more below the overall mean standard score. Small, statistically significant correlations were found between the MAND and BOT-2 SF tests for score rank (r = 0.370, p = 0.01) and standard score values (r = 0.404; p = 0.01). The overall decision agreement for non-MI cases was relatively high at 85% but very low for MI cases (4.4%). Unexpectedly, gender was balanced in MI cases. BOT-2 SF identified twice as many MI cases than MAND (13.2% vs 6.6%), yet overall comparative test specificity was high (89%). Predictive values for MAND, compared against BOT-2 SF as the standard, indicated broad independence between these tests and overall, the decision statistics indicated that the two tests identified different adult cohorts with MI. Objective classification of adult motor proficiency using a gold standard assessment tool including complex and ecologically valid tasks is still elusive.

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1. Introduction

For a number of children, estimated to range from 5 to 9% (Diagnostic Statistical Manual, 5th ed [DSM-V], APA, 2013; Slater, Hillier, & Civetta, 2010), motor coordination is significantly poorer than age expectations, learning new motor skills is difficult, and if the impairment interferes with school achievement or activities of daily living they are classified as having developmental coordination disorder (DCD). Currently, the prevalence of DCD in adult populations is not known but we have

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long standing evidence that DCD persists across time (Cantell, Smyth, & Ahonen, 1994, 2003; Geuze & Borger, 1993; Losse et al., 1991). According to the most recent edition, DSM-V (APA, 2013) about 50–70% of children with DCD have continuing motor coordination problems into adolescence and one could speculate that the prevalence into adulthood might be around 2–6 percent.

Another aspect is that we do not know whether the male:female gender imbalance for motor impairment in child clinical samples, commonly reported to be between 2:1 and 7:1 (DSM-V, APA, 2013), also holds in adulthood. In childhood, there is some indication that diagnosis of DCD, as distinct from measuring motor competence, may be somewhat biased towards identifying males (Larkin & Rose, 1999). When motor proficiency was objectively measured by the McCarron Assessment of Neuromuscular Development (MAND, McCarron, 1997) in a large sample of children attending regular primary schools, they found that the proportion of girls and boys classified as moderate impairment was similar (19.2% and 17.3%, respectively). It is plausible that gender differences in motor performance are age-related. For example, a longitudinal investigation of 986 youths by Hands, Larkin, and Rose (2013) found that the differences between males' and females' mean overall motor performance scores on the MAND test depended on age. At 10 years, females significantly outperformed the males, at 14 years there was no significant difference whereas by 17 years, males significantly outperformed the females.

Furthermore, while research has consistently shown that children with DCD experience adverse consequences of motor difficulties not only in "reduced participation in team play and sports (but) also 'poor self-esteem and sense of self-worth; emotional and behaviour problems; impaired academic achievement; poor physical fitness; and reduced physical activity and obesity" (DSM-V, APA, 2013, p. 76) there are still very limited studies regarding the impact of DCD in adulthood. Recent studies with this population have demonstrated some significant negative outcomes such as difficulties with learning to drive (Kirby, Sugden, & Edwards, 2011); lower participation in everyday activities, quality of life, and life satisfaction (Tal-Saban, Ornoy, & Parush, 2014); and increased risk for mental health difficulties (Hill & Brown, 2013; Kirby, Williams, Thomas, & Hill, 2013). However, in continuing to address these issues the need arises for age-appropriate, reliable and valid assessment tools of motor proficiency. Of interest to this paper is that the diagnostic Criterion B for DCD in the DSM-V has been extended to contexts relevant to adolescents and adults, such as 'assembling puzzles, building models, playing ball games (especially in teams), handwriting, typing, driving, or carrying out self-care skills' (p. 76). It would be interesting to determine whether the current standardised assessment tools for young adults incorporate these contexts.

A key psychometric feature for any test is its validity for measuring the behaviour and the population of interest. Concurrent validity, considered to be the strongest level of validity in clinical contexts, can be established by comparing the correlation and decision agreement between tests that purportedly measure the same construct (Portney & Watkins, 1993). Thus a test deemed to be a valid measure of a construct would be highly correlated to another similarly defined test; the case identification would also be highly sensitive (for true cases) but also highly specific (few misidentifications); and its predictive values would be high.

In the current study, the construct of interest is motor impairment (MI; being a subset of the motor proficiency spectrum). A tool that will maximise the identification of those with MI but also minimise misclassification is viewed as preferable. However, there is no agreed 'gold standard test' of MI (or DCD) in children or adults. Previous studies by Tan, Parker, and Larkin (2001), Crawford, Wilson, and Dewey (2001), and Brantner, Piek, and Smith (2009) compared the accuracy of identification of child MI cases by standardised tests also of interest to this study. Tan et al. (2001) compared the earlier edition of BOT-SF (Bruininks, 1978) with the MAND in a sample of children aged 5–11 years, independently classified with MI by several criteria, including the Movement Assessment Battery for Children (MABC, Henderson & Sugden, 1992). Decision agreement statistics showed that the accuracy of identification of those MABC identified MI cases by BOT-SF and MAND differed, with only 35% of those MI cases classified alike. Higher sensitivity statistics, along with higher values for negative predictions (fewer false negatives) pointed to the MAND being the more accurate discriminator of MI compared to BOT-SF.

Similarly, for older children aged 8–17 years, Crawford et al. (2001) compared the BOT, MABC and the Developmental Coordination Disorder Questionnaire (DCDQ). They found that the overall agreement between the tests was less than 80% and attributed the respective DCD cases as being due to the different structure and style of administration between the BOT and MABC tests. More recently, Brantner et al. (2009) compared the MAND with the MABC in a sample of young children aged 4–6 years. As in the earlier studies, they found a considerable degree of independence in classification by the two tests. They suggested that this could be partly explained by the different theoretical basis of each test, with the MAND having a neuropsychological approach but the MABC a functional approach, that tested skills required in every day motor tasks such as catching, tracing and manipulating real-life objects.

A recent review by Hands, Licari, and Piek (2015) revealed that, to date, there is no motor test developed specifically for assessing motor coordination difficulties in adults. Of the five motor assessment tools reviewed, only the MAND and BOT-2 had norms extending beyond early adolescence into young adulthood. They concluded that of the five tests, BOT-2 offered the most evidence for valid and reliable measurement of DCD diagnostic Criterion A of DSM-V however they state that no test adequately evaluated Criterion B. An analytical comparison of the efficacy of standardised tests for measuring motor competency in young adults is yet to be undertaken

Given no similar comparisons of statistical or MI classification have been published on motor assessment tools suitable for younger adults, the main purpose of this current study was to assess the discrimination accuracy and the decision agreement of MI and non-MI cases between two such motor tests; the MAND and the latest edition of BOT-2 SF. From Burton and Rodgerson's (2001) perspective tests are designed to either measure competence, where a benchmark of minimum performance identifies competency without capturing performances higher than the benchmark or measure proficiency, in which

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